National Institute of Environmental Health Sciences

The impact of regional climate change due to greenhouse forcing and land-use changes on malaria risk in tropical Africa

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Abstract:

Background: Climate change will probably alter the spread and transmission intensity of malaria in Africa. Objectives: In this study, potential changes in the malaria transmission are assessed via an integrated weather-disease model. Methods: We simulated mosquito biting rates by the Liverpool Malaria Model (LMM). The input data for the LMM were bias-corrected temperature and precipitation data from the Regional Model (REMO) on a 0.5 degrees latitude-longitude grid. A Plasmodium falciparum infection model expands the LMM simulations incorporating information on the infection rate in children. Malaria projections were carried out with this integrated weather-disease model for 2001-2050 according to two climate scenarios that include the effect of anthropogenic land use and land cover changes on climate. Results: Model-based estimates for the present climate (1960-2000) are consistent with observed data for the spread of malaria in Africa. In the model domain, the regions of epidemic malaria occurrence are located in the Sahel as well in various highland territories. A decreased spread of malaria over most parts of tropical Africa is projected due to simulated increased surface temperatures and a significant reduction in annual rainfall. However, the likelihood of malaria epidemics is projected to increase in the southern part of the Sahel. In most of East Africa, malaria transmission intensity is expected to increase. Projections indicate that highland areas that were formerly unsuitable for malaria will become epidemic, while in the lower altitude regions of the East African highlands, epidemic risk will decrease. Conclusions: We project that greenhouse gas and land use driven climate changes will significantly affect the spread of malaria in tropical Africa well before 2050. The geographic distribution of epidemic malaria areas might be strongly altered in the coming decades.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES), Other Climate Scenario

Special Report on Emissions Scenarios (SRES) Scenario: SRES A1, SRES B1

Other Climate Scenario: Liverpool malaria model

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Precipitation, Temperature, Unspecified Exposure

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

Tropical, Other Geographical Feature

Other Geographical Feature : highlands

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Africa

African Region/Country: African Region

Other African Region: Sahel region; eastern Africa

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction, Outcome Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale: ☒

time period studied

Medium-Term (10-50 years)

Vulnerability/Impact Assessment: ☒

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content